REMARKS

This application has been reviewed in light of the Office Action dated June 20, 2006. Claims 1-26 are pending in the application. By the present amendment, claim 10 has been amended to correct a minor typographical error. No new matter has been added. The Examiner's reconsideration of the rejection in view of the amendment and the following remarks is respectfully requested.

By the Office Action, claims 1-6, 10-12, 16-24 and 26 stand rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,871,268 to Iyengar et al. (hereinafter Iyengar).

Claim 1 of the present invention, includes, *inter alia*, a method including maintaining information regarding which storage elements are storing particular objects in a consistency coordinator which communicates with the storage elements, responding to a request to update an object by using maintained information to determine which of the storage elements may store a copy of the object, instructing the storage elements, which the consistency coordinator suspects store a copy of the object, to invalidate their copy of the object, and performing an update of the object after each storage element that includes the copy of the object indicates that the storage element has invalidated the copy of the object or the storage element is determined to be unresponsive.

Iyengar does not include a consistency coordinator. While Iyengar discloses a central cache, the central cache is not dedicated to maintaining information regarding which storage elements are storing particular objects. Instead the central cache is just that - a cache which communicates with the local caches to coordinate an update. While these devices seem

similar, there are some significant differences. For example, the central cache includes actual data content and is not a dedicated entity for maintaining information for all of the storage elements it serves. See e.g., Iyengar states at col. 5, lines 46-50, that " ...the central cache updates all objects it has cached which have changed".

Notwithstanding this, the present claims selectively target those storage elements that include an object to be updated by: "instructing the storage elements, which the consistency coordinator suspects store a copy of the object, to invalidate their copy of the object, and performing an update of the object after each storage element that includes the copy of the object indicates that the storage element has invalidated the copy of the object or the storage element is determined to be unresponsive".

The present steps provide for selective identification of which storage elements are updated. First, a limited number of storage elements are instructed by the consistency coordinator to invalidate and then only those that invalidated (or are unresponsive) are updated. There is no suggestion or equivalent recitation of these steps in Iyengar.

The coordinator in the present claims instructs storage elements that the coordinator suspects include a copy of the object to be updated to invalidate the storage element's copy. This is accurately performed since a complete set of information is maintained by the consistency coordinator. Then, for the storage elements that report that they invalidated their copy, the consistency coordinator updates the object. In this way, all versions of the object are invalidated and only the storage elements that have invalidated a version of the object need to be updated. Hence consistency is maintained in an efficient way without overburdening the system with unnecessary communications.

Upon careful review of the references and the present claim language, Iyengar does not teach the steps of at least instructing the storage elements, which the consistency coordinator suspects store a copy of the object, to invalidate their copy of the object, and performing an update of the object after each storage element that includes the copy of the object indicates that the storage element has invalidated the copy of the object or the storage element is determined to be unresponsive.

Claims 10, 11, and 17 include similar recitations as claim 1. Since Iyengar fails to teach the elements of the present claims, claims 1, 10, 11, and 17 are believed to be in condition for allowance for at least the stated reasons. Reconsideration of the rejection is earnestly solicited.

Furthermore, claim 18 recites, *inter alia*, a system for maintaining strong data consistency comprising a plurality of storage elements, a consistency coordinator, which communicates with the plurality of storage elements and maintains information about which objects are stored in the plurality of storage elements, the consistency coordinator providing selective communication to storage elements which include an object to be updated such that for a given object update the consistency coordinator communicates with only those storage elements which include the object to be updated.

Iyengar fails to disclose a consistency coordinator. While the central cache of Iyengar includes directories of local caches, the central cache may or may not have information about what is actually stored in the local caches. The directories of the central cache may not have been updated in accordance with changes occurring locally in the local caches. In this way, the central cache can merely guess as to what is contained in a given local cache. See e.g.,

col. 4, lines 30-36 in Iyengar.

However, the present claim 18 includes a consistency coordinator that maintains information about which objects are stored in the plurality of storage elements. The consistency coordinator provides selective communication to storage elements which include an object to be updated such that for a given object update the consistency coordinator communicates with only those storage elements which include the object to be updated. Such a feature is not suggested by Iyengar. Since the consistency coordinator includes all the information about what storage elements include which objects, the consistency coordinator can selectively communicate with those storage elements that actually include the object to be updated. For a given object update, the consistency coordinator communicates with only those storage elements that include the object to be updated. At least this feature is not taught by Iyengar.

Since Iyengar fails to teach the elements of the present claims, claim 18 is believed to be in condition for allowance for at least the stated reasons. In addition claims dependent from claim 1, 11, and 18 are also believed to be in condition for allowance for at least the stated reasons. Reconsideration of the rejection is earnestly solicited.

By the Office Action, claims 1-5, 10-12, 16-18, 21-22 and 26 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,497,480 to Hayes et al. (hereinafter Hayes).

Hayes is directed to a system for invalidating page table entries in a multi-processor system. It is respectfully submitted that Hayes is directed to a completely different arrangement of elements and performs its steps in a completely different way from those set forth in the present claims. Hayes provides a process that invalidates addresses in TLB buffers

to remove or demap virtual-to-physical memory addresses of previous processes. Hayes seeks to remove outdated or incorrect associations between virtual (cache) memory and physical memory. Consistency of data content stored in the cache and the physical memory is not addressed in Hayes.

Hayes does not disclose or suggest content consistency between multiple instances of an object. Instead, the only option in Hayes is to invalidate old virtual-to-physical memory address associations in order to make sure up-to-date associations are made between cache and physical memory. Data content is not addressed in Hayes. This alone is sufficient to overcome this reference in the rejection of the present claims since data consistency is not disclosed or suggested in Hayes. Further, Hayes fails to disclose or suggest a consistency coordinator, and Hayes fails to disclose or suggest that a selection of storage elements is made that actually includes the object to be updated, among other things.

Claim 1 of the present invention, includes, *inter alia*, a method including maintaining information regarding which storage elements are storing particular objects in a consistency coordinator which communicates with the storage elements, responding to a request to update an object by using maintained information to determine which of the storage elements may store a copy of the object, instructing the storage elements, which the consistency coordinator suspects store a copy of the object, to invalidate their copy of the object, and performing an update of the object after each storage element that includes the copy of the object indicates that the storage element has invalidated the copy of the object or the storage element is determined to be unresponsive.

As stated, Hayes does not disclose or suggest a consistency coordinator. While

there is a distributed system for carrying out the steps of Hayes, as the Examiner suggests, the distributed system of Hayes does not provide a device or equivalent device that performs the function of the consistency coordinator of the present claims. The consistency coordinator provides consistency between the storage elements it serves by maintaining information of which storage elements are storing particular objects.

In Hayes, there is no single entity that maintains information about what objects are stored in which storage elements. Therefore, Hayes cannot determine where virtual-to-physical address associations (table entries) are located to be invalidated. This is easily seen from the need in Hayes to broadcast information to all processors in the system. By broadcasting, all processors must identify themselves as having the invalid table entry. Hayes broadcasts the request so that all entities can check for themselves (see col. 2, lines 26-30) as to whether or not they have a particular entry that is to be invalidated. Hence, Hayes does not maintain information about storage elements as provided by a consistency coordinator as recited by the present claims. Instead, each processor must receive, analyze and reply to each broadcast, whether or nor they are actually affected by the request packet.

In stark contrast, the consistency coordinator in accordance with the present claims responds to a request to update an object by using its maintained information to determine which of the storage elements may store a copy of the object, and then instructs the storage elements, which the consistency coordinator suspects store a copy of the object, to invalidate their copy of the object. The process is selective so that only those storage elements affected by a change are notified and need respond. In this way, an update of the object is performed after each storage element, that includes the copy of the object, indicates that the

storage element has invalidated their copy of the object or the storage element is determined to be unresponsive. Hayes fails to disclose or suggest at least these features.

Claims 10, 11, and 17 include similar recitations as claim 1. Since Hayes fails to teach or suggest all of the elements of the present claims, claims 1, 10, 11, 17 and 18 are believed to be in condition for allowance for at least the stated reasons. In addition claims dependent from claims 1, 11, and 18 are also believed to be in condition for allowance for at least the stated reasons. Reconsideration of the rejection is earnestly solicited.

By the Office Action, claims 7-9, 14-15 and 25 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Hayes in view of U.S. Application Patent No. 2005/0128960 to Chang et al. (hereinafter Chang).

Chang is cited to cure the deficiencies of Hayes, namely with respect to heartbeat messages. While Change includes heartbeat messages, these messages are employed in a completely different way. Therefore, Chang fails to cure the deficiencies of Hayes as set forth above. Further claims 7-9, 14-15 and 25 are dependent from independent claims which are believed to be in condition for allowance and are therefore also believed to be allowable for at least the stated reasons. Reconsideration of the rejection is earnestly solicited.

It should be noted that the present application, Iyengar and Chang are all commonly assigned to the same entity, International Business Machines. The Applicant will consider filing a terminal disclaimer to overcome any obvious-type double patenting rejections. In any event, the Applicant believes that the prior art exclusion under §103(c) (MPEP 706.2) is applicable to one or more of the rejections made by the Examiner. Reconsideration is respectfully requested.

In view of the foregoing amendments and remarks, it is respectfully submitted that all the claims now pending in the application are in condition for allowance. Early and favorable reconsideration of the case is respectfully requested.

It is believed that no additional fees or charges are currently due. However, in the event that any additional fees or charges are required at this time in connection with the application, they may be charged to applicant's IBM Deposit Account No. 50-0510.

Respectfully submitted,

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